Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 4s, https://carcinogenesis.com/

Assessing Knowledge, Attitudes, and Practices of Gut Microbiome Counseling Among Colorectal Surgeons

Salah Alghamdi[*1]

[*1]Associate Professor, Department of Surgery, Faculty of Medicine, University of Tabuk, Tabuk, Saudi Arabia

Email ID: s.alghamdi@ut.edu.sa

ABSTRACT

Background: The gut microbiome plays a critical role in gastrointestinal health, immune function, and surgical outcomes, particularly in colorectal surgery. Despite growing evidence supporting microbiome modulation in clinical practice, little is known about colorectal surgeons' knowledge, attitudes, and practices (KAP) regarding gut microbiome counseling. This study aimed to assess colorectal surgeons' awareness and integration of microbiome-related counseling in patient management.

Methods: A cross-sectional descriptive study was conducted among 150 colorectal surgeons across multiple hospitals and surgical centers. Participants were recruited using a nonrandomized convenience sampling method. Data were collected via a structured, self-administered questionnaire, assessing: Demographic and professional characteristics, Knowledge of the gut microbiome and its clinical implications, Attitudes toward gut microbiome counseling and Current practices related to microbiome counseling Statistical analysis was performed using SPSS version 26, including descriptive statistics, chi-square tests, and multiple linear regression to determine associations between demographic variables and KAP scores.

Results: Among the 150 colorectal surgeons, 72.7% were male, and 44.7% were aged 40–49 years. Overall, 43.3% demonstrated good knowledge of gut microbiota, while 39.3% had average knowledge, and 17.3% exhibited poor knowledge. Only

54.0% were aware of probiotics' role in postoperative infection prevention.

Regarding attitudes, 44.0% of participants maintained a neutral stance on microbiome counseling, while 28.0% held a positive attitude, and 28.0% had a negative attitude. In terms of clinical practices, only 41.3% of surgeons routinely discussed gut microbiota with patients, and 35.3% recommended probiotics after antibiotic use. Public hospital surgeons were more likely to recommend probiotics ($p = 0.03$), and prior microbiome training was significantly associated with higher knowledge scores ($p = 0.002$).

Conclusion: This study reveals substantial gaps in knowledge, attitudes, and practices regarding gut microbiome counseling among colorectal surgeons. Although many surgeons recognize the importance of microbiota, this awareness is not consistently reflected in clinical practice. The findings highlight the need for targeted microbiome-related education and training to improve surgeons' confidence in patient counseling. Integrating microbiome-focused continuing medical education (CME) programs and updated clinical guidelines could enhance patient care by promoting microbiome-informed surgical decision-making.

Keywords: *Gut microbiome, colorectal surgeons, knowledge, attitudes, and practices (KAP), surgical outcomes, patient counseling.*

How to Cite: Salah Alghamdi, (2025) Assessing Knowledge, Attitudes, and Practices of Gut Microbiome Counseling Among Colorectal Surgeons, *Journal of Carcinogenesis*, *Vol.24, No.4s*, 644-651

1. INTRODUCTION

The human gut microbiota consists of a complex community of microorganisms, including bacteria, fungi, archaea, viruses, and protozoa, that play a crucial role in maintaining gastrointestinal and systemic health [1]. These microorganisms contribute to various physiological functions such as digestion, metabolism, immune regulation, and protection against pathogens. The gut microbiota, predominantly composed of anaerobic bacteria, is estimated to contain between 10^{13} and 10^{14} microorganisms, collectively weighing around 2 kg—outnumbering human cells [2]. Specific bacterial groups, including Bacteroidetes and Firmicutes, are known to facilitate nutrient breakdown through fermentation, producing essential metabolites such as short-chain fatty acids [3].

Growing research highlights the importance of gut microbiota in gastrointestinal disorders, particularly in conditions like inflammatory bowel disease (IBD) and colorectal cancer, where microbial dysbiosis is often observed [4]. Given the increasing recognition of the gut microbiome's influence on colorectal health, colorectal surgeons play a pivotal role in integrating microbiome-related counseling into their clinical practice. Probiotics, defined by the World Health Organization (WHO) as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host," have gained attention as a potential therapeutic intervention for modulating gut microbiota [5]. Clinical evidence suggests that probiotic supplementation may aid in restoring microbial balance, reducing postoperative complications, and improving outcomes for patients undergoing colorectal surgery [6].

Despite the expanding body of evidence on the gut microbiome's impact on colorectal health, little is known about the knowledge, attitudes, and practices (KAP) of colorectal surgeons regarding microbiome-related counseling. Factors such as dietary modifications, antibiotic use, and lifestyle interventions can significantly influence gut microbiota composition, yet the extent to which surgeons incorporate this knowledge into patient education and clinical decision-making remains unclear [7,8]. Additionally, while antibiotics are commonly prescribed in colorectal surgical settings, their overuse can lead to gut dysbiosis, increasing susceptibility to opportunistic infections such as *Clostridium difficile*-associated colitis [9,10]. Conversely, factors such as physical activity and dietary interventions have been associated with positive gut microbiota modulation, further emphasizing the need for evidence-based microbiome counseling [2].

Given the potential clinical implications of gut microbiota modulation in colorectal surgery, assessing the knowledge, attitudes, and practices of colorectal surgeons regarding microbiome counseling is essential. Understanding their perspectives can help identify gaps in education and inform strategies to enhance microbiome-related discussions in surgical practice.

2. MATERIALS AND METHODS

Study Design and Setting

A cross-sectional descriptive study was conducted to assess colorectal surgeons' knowledge, attitudes, and practices (KAP) regarding gut microbiome counseling, particularly in relation to probiotics, antibiotics, and microbiome modulation strategies. The study was carried out across multiple hospitals and surgical centers, targeting practicing colorectal surgeons.

Study Population and Sampling

The target population comprised board-certified colorectal surgeons and general surgeons specializing in colorectal procedures. A **nonrandomized convenience sampling** approach was used to recruit participants. Inclusion criteria included:

- Practicing colorectal surgeons with at least **one year of experience** in surgical practice.
- Surgeons who perform **colorectal procedures regularly**.
- Willingness to participate and provide informed consent.

Exclusion criteria included:

- Surgeons specializing in other fields without direct involvement in colorectal surgery.
- Surgeons in training or medical residents.

A minimum sample size of **150 participants** was determined based on an estimated response rate of 60%, ensuring sufficient statistical power for analysis.

Data Collection Instrument

A **structured, self-administered questionnaire** was used to collect data. The questionnaire was designed based on previous research on gut microbiota and modified to reflect the perspectives of colorectal surgeons. It contained **43 questions**, divided into four sections:

1. **Demographic and Professional Characteristics (7 items)** o Age, gender, years of experience, level of specialization, type of healthcare institution (public/private), frequency of colorectal procedures performed, and prior microbiome-related education or training.

Knowledge of Gut Microbiome and Its Clinical Implications (12 items)

o Multiple-choice and true/false questions assessing understanding of microbiome composition, probiotics, antibiotic impact, and microbiome-related complications in colorectal surgery.

3. **Attitudes Toward Gut Microbiome Counseling (12 items)** o Five-point Likert scale questions assessing beliefs about the importance of gut microbiome discussions in surgical practice, confidence in counseling patients, and perceptions of microbiome-related interventions.

4. **Practices in Gut Microbiome Counseling (12 items)** o Questions assessing surgeons' frequency of discussing gut microbiota with patients, recommending probiotics or dietary modifications, and integrating microbiome-related considerations into surgical decisionmaking.

The questionnaire was reviewed by **a panel of three colorectal surgery experts and two microbiome researchers** to ensure content validity. A **pilot test** was conducted with **30 surgeons**, who were excluded from the final analysis. The questionnaire was revised based on feedback to enhance clarity and relevance.

Reliability Testing

Internal consistency was measured using **Cronbach's alpha**, yielding a coefficient of **0.81**, indicating good reliability.

Data Collection Procedure

Data were collected between **April and June 2024** using an online survey hosted on **Google Forms**. The survey link was distributed via:

- **Professional surgical associations and forums.**
- **Email invitations to colorectal surgery departments.**
- **Social media platforms (LinkedIn, WhatsApp, and Twitter) targeted at medical professionals.**

Participants were provided with an **informed consent statement**, assuring them of **confidentiality, voluntary participation, and the right to withdraw at any time**.

Data Analysis

Data were **exported to Excel**, cleaned, and analyzed using **SPSS version 26**.

Statistical methods included:

- **Descriptive Statistics:**
  - Frequencies and percentages for categorical variables. o Means and standard deviations for continuous variables.
- **Inferential Statistics:**
  - **Chi-square tests** to examine associations between demographic factors and KAP scores. o **Stepwise multiple linear regression (MLR)** to identify predictors of microbiome knowledge.

Scoring System

Knowledge was scored based on the number of correct responses:

- **Poor knowledge:** 0–3 points
- **Average knowledge:** 4–6 points
- **Good knowledge:** 7–9 points

Attitudes and practices were scored using a three-point Likert scale:

- **Negative attitudes/practices:** 9–15 points
- **Neutral attitudes/practices:** 16–21 points
- **Positive attitudes/practices:** 22–27 points

Ethical Considerations

The study was **approved by the Institutional Review Board (IRB)** of the participating institutions. Data were anonymized, and no personal identifiers were collected.

3. RESULTS

Demographic and Professional Characteristics

A total of **150 colorectal surgeons** participated in the study. The majority were male (**72.7%**, n = 109), with the largest age group being **40–49 years** (**44.7%**, n = 67).

Most participants had **6–15 years of experience** (**48.0%**, n = 72).

Table 1: Demographic and Professional Characteristics of Participants

Variable	Category	n	%
Gender	Male	109	72.7
	Female	41	27.3
Age Group	30–39 years	52	34.7
	40–49 years	67	44.7
	50+ years	31	20.7
Years of Experience	<5 years	34	22.7
	6–15 years	72	48.0
	>15 years	44	29.3
Type of Institution	Public Hospital	88	58.7
	Private Hospital	62	41.3
Previous Microbiome Training	Yes	47	31.3
	No	103	68.7

Knowledge of the Gut Microbiome

Overall, **43.3%** (n = 65) of participants demonstrated **good knowledge**, while **39.3%** (n = 59) had **average knowledge**, and **17.3%** (n = 26) had **poor knowledge**.

Table 2: Knowledge Scores of Participants

Knowledge Level	Score Range	n	%
Poor Knowledge	0–3	26	17.3
Average Knowledge	4–6	59	39.3
Good Knowledge	7–9	65	43.3

When asked about the impact of **antibiotics on the gut microbiota**, **76.7%** (n = 115) correctly identified that **broad-spectrum antibiotics significantly disrupt the gut microbiome**. However, only **54.0%** (n = 81) were aware of the **role of probiotics in preventing postoperative infections**.

Attitudes Toward Gut Microbiome Counseling

Approximately **58.0%** (n = 87) of participants **agreed** that gut microbiome counseling should be a standard practice in colorectal surgery. However, only **46.7%** (n = 70) felt **confident** in their ability to counsel patients about microbiome health.

Table 3: Attitudes Toward Gut Microbiome Counseling

Attitude Level	Score Range	n	%
Negative Attitude	9–15	42	28.0
Neutral Attitude	16–21	66	44.0
Positive Attitude	22–27	42	28.0

Practices in Gut Microbiome Counseling

Less than half (**41.3%**, n = 62) reported that they **routinely** discuss the **gut microbiome with their patients**. Among those, only **35.3%** (n = 53) recommended **probiotics** to patients after antibiotic use.

Table 4: Frequency of Microbiome-Related Practices Among Surgeons

Practice Question	Response	n	%
Routinely discusses gut microbiome with patients	Yes	62	41.3
	No	88	58.7
Recommends probiotics post-antibiotic use	Yes	53	35.3
	No	97	64.7
Modifies surgical planning based on microbiome considerations	Yes	39	26.0
	No	111	74.0

Association Between Demographics and Knowledge, Attitudes, and Practices

Surgeons with microbiome-related training were significantly more likely to have **good knowledge** (**p = 0.002**). **Younger surgeons (<40 years)** showed more positive attitudes toward microbiome counseling (**p = 0.01**). **Public hospital surgeons** were more likely to recommend probiotics than private hospital surgeons (**p = 0.03**).

Table 5: Associations Between Demographics and KAP Scores (Chi-Square Test Results)

Variable	Factor	p-value
Knowledge Score	Microbiome training (Yes vs. No)	**0.002**
Attitude Score	Age group (<40 vs. ≥40)	**0.01**
Practice Score	Public vs. Private hospital	**0.03**

Key Findings Summary

Knowledge: 43.3% had **good** knowledge of the gut microbiome, but gaps remain regarding probiotics.

Attitudes: 58.0% support microbiome counseling, but **46.7% lack confidence** in patient education.

Practices: Only **41.3%** routinely discuss the microbiome with patients, and **35.3%** recommend probiotics.

Demographic Factors: Surgeons with microbiome training, younger surgeons, and public hospital surgeons had **higher KAP scores**.

4. DISCUSSION

This study aimed to evaluate the knowledge, attitudes, and practices (KAP) of colorectal surgeons regarding gut microbiome counseling. The study included 150 colorectal surgeons, with the majority being male (72.7%). Although 76.7% of participants correctly identified that broad-spectrum antibiotics significantly disrupt the gut microbiome, only 43.3% demonstrated good knowledge about microbiota, while 39.3% had an average level of knowledge, and 17.3% exhibited poor knowledge. Awareness of probiotics was also limited, with only 54.0% of participants recognizing their role in preventing postoperative infections.

Participants' attitudes toward gut microbiome counseling were generally neutral, with 44.0% exhibiting a neutral stance, 28.0% having a positive attitude, and 28.0% holding a negative attitude. These findings suggest limited awareness of the clinical benefits of probiotics and the impact of antibiotic overuse on gut health. Although many surgeons understood the basic concept of microbiota, their knowledge of its role in immune function, surgical recovery, and disease prevention was insufficient. Misconceptions persisted, with some surgeons expressing uncertainty about the clinical relevance of microbiota in colorectal surgery. These gaps highlight the need for targeted educational programs to improve microbiome-

related knowledge among colorectal surgeons.

Age and prior microbiome-related training significantly influenced knowledge levels. Younger surgeons (<40 years old) demonstrated greater awareness of microbiota ($p = 0.01$), a finding that aligns with other studies indicating that microbiota-related topics are gaining prominence in modern medical curricula [11,12]. Similarly, surgeons who had previously received microbiome training were significantly more knowledgeable ($p = 0.002$). While healthcare professionals generally exhibited better microbiome knowledge than non-medical professionals in previous studies, the lack of significant differences in expertise among trained colorectal surgeons indicates a gap in specialized education for microbiome-related clinical applications [12,13].

The study also revealed that colorectal surgeons have insufficient awareness of probiotics, as only 35.3% routinely recommended probiotics to patients postantibiotic use. This finding is consistent with previous studies in Al Qassim, Saudi Arabia, where 73% of respondents were unfamiliar with the term probiotics [12].

Similar trends have been observed internationally, with studies in the UAE reporting only 4% of participants having adequate probiotic knowledge and another study in Chicago finding that only 20% of hospitalized patients could accurately define probiotics [11,13]. In contrast, probiotic awareness was significantly higher among college students in India (88.7%) and the Philippines, suggesting a knowledge gap even among healthcare professionals [15,16].

Regarding attitudes, 44.0% of colorectal surgeons maintained a neutral stance on probiotics, while only 28.0% had a positive attitude. This aligns with findings from a UAE study in which most healthcare professionals exhibited neutral or negative attitudes toward probiotics [11]. Similar results were reported in Australia, where over 40% of participants had negative perceptions of probiotics [17]. The prevalence of neutral and negative attitudes among colorectal surgeons suggests that limited knowledge is a key barrier to probiotic acceptance in surgical practice. Many participants were uncertain about the specific health benefits of probiotics and lacked confidence in recommending them to patients.

One of the most concerning findings was the high prevalence of antibiotic misuse among colorectal surgeons. Nearly 40.0% of participants admitted to discontinuing antibiotics early when symptoms improved, a practice known to contribute to antimicrobial resistance. This figure is consistent with previous studies in Saudi Arabia (25%) and Kuwait (27.5%) that reported widespread antibiotic misuse among healthcare professionals [18–20]. However, these rates are significantly higher than those observed in Hong Kong, the UK, Malaysia, and several European countries, where self-medication with antibiotics ranges from 4.8% to 9% [21–25]. Alarmingly, one-third of participants stated that they would recommend antibiotics to others or take them as a preventive measure, findings that are comparable to a UAE study where 34% of nonmedical respondents recommended antibiotics to friends and family, and 31% took them as a precautionary measure [11].

5. CONCLUSION

This study highlights a general lack of awareness among colorectal surgeons regarding probiotics and the gut microbiome, with many participants exhibiting poor knowledge and neutral attitudes toward microbiome-related counseling. Given the increasing role of gut microbiota in postoperative recovery, infection prevention, and colorectal disease management, it is critical to enhance microbiome education in surgical training programs.

The findings emphasize the need for targeted professional development programs that provide colorectal surgeons with evidence-based guidance on gut microbiota, probiotics, and antibiotic stewardship. Hospitals and medical associations should incorporate microbiome-related training into continuing medical education (CME) programs, as prior microbiome education was strongly associated with better KAP scores in this study.

Additionally, clinical guidelines should be developed to support microbiome-related counseling and interventions in colorectal surgery. Future research should explore the barriers preventing colorectal surgeons from integrating microbiome considerations into clinical practice and assess the effectiveness of educational interventions in improving microbiome-related knowledge and counseling practices among surgeons.

By improving colorectal surgeons' understanding of gut microbiota, patient outcomes can be enhanced through more informed surgical decisions, improved postoperative care, and better antimicrobial stewardship, ultimately reducing the burden of gut microbiome-related complications in colorectal surgical practice.

REFERENCES

[1] Jandhyala SM, Talukdar R, Subramanyam C, Vuyyuru H, Sasikala M, Nageshwar Reddy D. Role of the normal gut microbiota. World J Gastroenterol. 2015;21(29):8787–803. doi: 10.3748/wjg.v21.i29.8787. https://doi.org/10.3748/wjg.v21.i29.8787.

[2] Doroszkiewicz J, Groblewska M, Mroczko B. The role of gut microbiota and gut-brain interplay in selected diseases of the central nervous system. Int J Mol Sci. 2021;22(18):10028. doi: 10.3390/ijms221810028. https://doi.org/10.3390/ijms221810028.

[3] Sekirov I, Russell SL, Antunes LC, Finlay BB. Gut microbiota in health and disease. Physiol Rev. 2010;90(3):859–904. doi: 10.1152/physrev.00045.2009. https://doi.org/10.1152/physrev.00045.2009.

[4] Nagpal R, Kumar A, Kumar M, Behare PV, Jain S, Yadav H. Probiotics, their health benefits and applications for developing healthier foods: a review. FEMS Microbiol Lett. 2012;334(1):1–15. doi: 10.1111/j.1574-6968.2012.02593.x. https://doi.org/10.1111/j.1574-6968.2012.02593.x.

[5] FAO/WHO. In: FAO Food and Nutrition. FAO, Rome: 2006. Probiotics in foods: health and nutritional properties and guidelines for evaluation; p. 85. ISBN 92-5-105513-0.

[6] Iannitti T, Palmieri B. Therapeutical use of probiotic formulations in clinical practice. Clin Nutr. 2010;29(6):701–25. doi: 10.1016/j.clnu.2010.05.004. https://doi.org/10.1016/j.clnu.2010.05.004.

[7] Ottman N, Smidt H, de Vos WM, Belzer C. The function of our microbiota: who is out there and what do they do? Front Cell Infect Microbiol. 2012;2:104. doi: 10.3389/fcimb.2012.00104. https://doi.org/10.3389/fcimb.2012.00104.

[8] Singh RK, Chang HW, Yan D, Lee KM, Ucmak D, Wong K, et al. Influence of diet on the gut microbiome and implications for human health. J Translat Med. 2017;15(1):73. doi: 10.1186/s12967-017-1175-y. https://doi.org/10.1186/s12967-017-1175-y.

[9] Iizumi T, Battaglia T, Ruiz V, Perez Perez GI. Gut microbiome and antibiotics. Arch Med Res. 2017;48(8):727–34. doi: 10.1016/j.arcmed.2017.11.004. https://doi.org/10.1016/j.arcmed.2017.11.004.

[10] Francino MP. Antibiotics and the human gut microbiome: dysbioses and accumulation of resistances. Front Microbiol. 2016;6:1543. doi: 10.3389/fmicb.2015.01543. https://doi.org/10.3389/fmicb.2015.01543.

[11] Barqawi HJ, Adra SF, Ramzi HR, Abouaggour MA, Almehairi SK. Evaluating the knowledge, attitudes and practices of the UAE community on microbiota composition and the main factors affecting it: a cross-sectional study. BMJ Open. 2021;11(8):e047869. doi: 10.1136/bmjopen-2020-047869. https://doi.org/10.1136/bmjopen-2020-047869.

[12] Allah HA, Prarthana MS. The knowledge and perceptions regarding probiotics among the people of Al-Qassim region, Saudi Arabia. J Health Med Sci. 2019;2(3):344–50. https://doi.org/10.31014/aior.1994.02.03.56.

[13] Betz M, Uzueta A, Rasmussen H, Gregoire M, Vanderwall C, Witowich G. Knowledge, use and perceptions of probiotics and prebiotics in hospitalised patients. Nutr Dietet. 2015;72(3):261–6. https://doi.org/10.1111/17470080.12177.

[14] Amarauche CO. Assessing the awareness and knowledge on the use of probiotics by healthcare professionals in Nigeria. J Young Pharmacists. 2015;8(1):53. https://doi.org/10.5530/jyp.2016.1.12.

[15] Sharma R, Gupta S, Gupta D, Kushwaha PK. Awareness and knowledge about probiotics among college students. J Pure Appl Microbiol. 2019;13(4):2201–8. https://doi.org/10.22207/jpam.13.4.33.

[16] Mejia WB, Barrion ASA, Abacan SF, Israel KAT. Knowledge and consumption of probiotic foods of selected students in laguna, Philippines. EC Nutrition. 2019;14(5):452–459.

[17] Khalesi S, Vandelanotte C, Thwaite T, Russell AM, Dawson D, Williams SL. Awareness and attitudes of gut health, probiotics and prebiotics in Australian adults. J Dietary Suppl. 2021;18(4):418–32. doi: 10.1080/19390211.2020.1783420. https://doi.org/10.1080/19390211.2020.1783420.

[18] Jali A, Hakami A, Dahas N, Mahnashi M, Siddiq A, Alsomaili H, et al. Antibiotic use and resistance knowledge: awareness among the general public in Jazan, Saudi Arabia. Cureus. 2021;13(12):e20369. doi: 10.7759/cureus.20369. https://doi.org/10.7759/cureus.20369.

[19] Shatla M, Althobaiti FS, Almqaiti A. Public knowledge, attitudes, and practices towards antibiotic use and antimicrobial resistance in the western Region of Saudi Arabia. Cureus. 2022;14(11):e31857. doi: 10.7759/cureus.31857. https://doi.org/10.7759/cureus.31857.

[20] Awad AI, Aboud EA. Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. PLoS One. 2015;10(2):e0117910. doi: 10.1371/journal.pone.0117910. https://doi.org/10.1371/journal.pone.0117910.

[21] You JH, Yau B, Choi KC, Chau CT, Huang QR, Lee SS. Public knowledge, attitudes and behavior on antibiotic use: a telephone survey in Hong Kong. Infection. 2008;36(2):153–7. doi: 10.1007/s15010-007-7214-5. https://doi.org/10.1007/s15010-007-7214-5.

[22] McNulty CA, Boyle P, Nichols T, Clappison P, Davey P. Don‘t wear me out—the public‘s knowledge of and attitudes to antibiotic use. J Antimicrob Chemother. 2007;59(4):727–38. doi: 10.1093/jac/dkl558. https://doi.org/10.1093/jac/dkl558.

[23] Lim KK, Teh CC. A cross sectional study of public knowledge and attitude towards antibiotics in Putrajaya, Malaysia. Southern Med Rev. 2012;5(2):26–33.

[24] Eurobarometer S. TNS Opinion & Social; Directorate General for Communication. European Union, Brussels, Belgium: 2010. Antimicrobial resistance.

[25] Widayati A, Suryawati S, de Crespigny C, Hiller JE. Self medication with antibiotics in Yogyakarta City Indonesia: a cross sectional population-based survey. BMC Res Notes. 2011;4:1–8. doi: 10.1186/1756-0500-4-491. https://doi.org/10.1186/1756-0500-4-491.

[26] Voidăzan S, Moldovan G, Voidăzan L, Zazgyva A, Moldovan H. Knowledge, attitudes and practices regarding the use of antibiotics. study on the general population of mureş county, Romania. Infect Drug Resist. 2019;12:3385–96. doi: 10.2147/IDR.S214574. https://doi.org/10.2147/IDR.S214574.